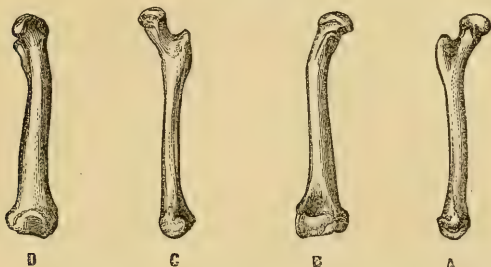


	<i>G. newtonii</i> . millims.	<i>G. verus</i> . millims.
Least width of os ischii	2½	11
Length of femur	26	30
Width in the middle	1½	3
Width of its lower extremity	5½	7½

Fig. 6.

The femur of *Gecko newtonii* in four different aspects and of natural dimension.

On *Myodes lemmus* in Norway. By ROBERT COLLETT, Conservator University Museum, Christiania, C.M.Z.S., &c. (Communicated by Dr. J. MURIE.)

[Read April 5, 1877.]

In the previous year's publications of this Society are some articles by Mr. Duppa Crotch on the Norwegian Lemming (*Myodes lemmus*)*. As the habits and the economy of this mysterious little animal must always have considerable interest for any one who has the opportunity of observing it in the state of nature, I have considered that a few remarks on the same subject, being the result of personal experience, may be deemed worthy of notice, more especially as my personal observations in some respects differ from the statements made by Mr. Crotch. The following notes with some additions and abbreviations may be considered in the light of a partial translation of an article of mine in a memoir on the mammals of Norway, published in Christiania, March 1876†, and are here communicated by the desire of my friend Dr. Murie.

* 1. "On the Migration and Habits of the Norwegian Lemming," vol. xiii. p. 27 (Sept. 19, 1876). 2. "Additional Note relative to the Norwegian Lemming," vol. xiii. p. 83 (Dec. 15, 1876). 3. "Further Remarks on the Lemming," vol. xiii. p. 157 (Feb. 28, 1877).

† "Bemærkninger til Norges Pattedyrfauna," p. 18 (Nyt Magazin for Naturvidenskaberne, 22 B., Kristiania, 1876).

Myodes lemmus inhabits all the high fells of Norway from the southern branches of the Lemgfjeldene in Christiansand Stift to the North Cape and the Varangerfjord. South of the Arctic Circle its habitat is exclusively confined to the plateaux above the conifer region; in Tromsø Amt and in Finmarken it occurs on all suitable localities down to the level of the sea, and here, too, it is resident on the larger islands on the coast.

None of the eastern species and no constant race of the Lemming are found in Norway, and accidental varieties are exceedingly scarce. A few specimens of albinos are known.

Under ordinary circumstances it inhabits portions of the birch-regions on the fells, intermixed with dry juniper-covered ground and wet soil covered with the Dwarf Birch (*Betula nana*); in the daytime it remains hidden and is seldom observed, but is, however, never wanting on places of any extent with the above-mentioned natural qualifications.

The nest is found under a tussock, constructed of dry short straws, and is often, but not always, lined with hairs cast off by the animals themselves. The number of the young ones (excepting in years of migration) is generally five, sometimes only three, seldom seven to eight; and at least two sets are annually produced.

It feeds entirely on vegetable matter, especially grass-roots and straws, in winter bark of different species of Willow (*Salix*) and Birch (*Betula*); and it forms the staple food of the Snowy Owl (*Nyctea scandiaca*), the Rough-legged Buzzard (*Buteo lagopus*), the Short-eared Owl (*Asio accipitrinus*), the Arctic Fox (*Vulpes lagopus*), the Glutton (*Gulo borealis*), the Stoat (*Mustela erminea*), and, to some extent, Buffon's Skua (*Lestris parasitica*).

The wandering of the Lemmings, is a necessary consequence of their temporarily strong vitality together with an extreme migratory instinct, which is chiefly developed when they are in numbers. This tendency to appear in large numbers at irregular intervals of years is common to all the species of the subfamily Arvicolinæ; but in the present species (*Myodes lemmus*) it is probably more developed than in any other mammal.

During some years more families are produced than in others, without a migration consequently arising. Should the circumstances be favourable, and the families still more numerous, the increase in number causes smaller migrations, which every year take place here

and there, and is shown in the sporadic appearance of individuals down into the nearest valleys; and between these smaller and the true migrations every gradation is to be found.

This is a point that ought not be overlooked.

In some years the reproduction is still stronger, and the sudden collection of individuals of an animal that under ordinary circumstances seems to be nowhere very numerous distributed, but always keep themselves scattered on the larger plateaux, will naturally cause a movement of the masses towards the sides, so as again to make the balance even; and by the natural desire to wander possessed by this species (which is also to a certain extent shown by the allied species of Lemming, *M. schisticolor*, Lilljeb., and also in some of the other species of Arvicolinæ), these migrations very soon reach the borders of the plateaux, and subsequently spread over an area that is considerably larger than obtains in any other of the species under similar circumstances.

In cases where in two succeeding years the production of young has been excessive, the masses are incessantly pushed towards the sides of the fells; and the migration becomes an overrunning of the lower and far remote portions of the country, as the individuals gradually penetrate further in search of localities suitable to their habits (and which are capable of giving them a permanent subsistence), until they are stopped by the sea or destroyed in some other manner.

In the years of the great migrations the first families reared in the spring reproduce in the autumn of the same year, causing an over-population. This drives the individuals to wander down to the plains, often before they are full-grown. The next year the masses may increase in number to such an extent, that myriads continually move from the central plateaux and overrun the lowlands, where they join those that have previously arrived. Many pairs breed during the journey; they are therefore more numerous in the late summer, become less so in the autumn, die in immense masses in the winter, are seen, though sparingly, the next spring, and disappear gradually during the summer (the second year of their wandering). This stage of increasing and disappearing is the rule in many instances; but, as previously said, the migrations may be shorter as well as longer, and then not be finished before the third year from their starting from the fells.

In the years of migration the families follow each other quickly, and the set consists sometimes of nine, and not unusually of ten, young.

The greater number of those individuals that wander are young and born in one of the last two years; and I have observed that they chiefly consist of males, the number of females being regularly very small.

The migration is brought to a close by the death of the swarms, which is generally caused by an epizootic disease, the necessary consequence of over-population. As this disease develops itself on the high fells as well as on the lowlands, it cannot be caused by the unusual mode of living of the wanderers; for directly after these migrations the high fells seem almost devoid of inhabitants. The larger the masses, the higher is the mortality; and this is increased by the heat and want of drinking-water. During the great migrations one can easily witness the sudden deaths amongst the horde, many of their bodies appearing to be quite uninjured; though most of the specimens examined show the lower part of the back almost denuded of hairs, and the skin covered with small tubercles. These abrasions and pustules, in my opinion, are the result of a disease of the skin, and not due to the habit of backing up against a stone, or caused by their running into their underground holes, as has been commonly affirmed. No individual returns of its own will to the fells after it has once descended and moved any distance from the plateaux.

During the migrations they are devoured (besides by the mammals and birds of prey of the above-mentioned species that follow them down to the lowlands) chiefly by the Common Kestrel (*Falco tinnunculus*), the Common Buzzard (*Buteo vulgaris*), all the Owls (*Strigidæ*), and the other birds of prey, the Weasel (*Mustela nivalis*) and Fox (*Vulpes vulgaris*); further by Crows (*Corvidæ*) of different kinds, and in the northern parts of the country by species of Gulls and Skuas (*Larus* and *Lestris*); and it must be reckoned amongst the anomalies in the habits of the tame Ruminants that they (chiefly the cattle and goats) sometimes betake themselves to killing and eating the Lemmings. This is the case, too, with the wild Reindeer on the southern fells, and the same in Finmarken. Numbers are killed by dogs and cats; and men everywhere try with all their power to diminish their numbers.

The immediate reason for the large increase of Lemmings is doubtless owing to exceptional circumstances repeated for some

years, and consequently favouring their pairing and bringing up of their young; the result of which is far greater numbers of families and larger numbers of young in each set than in ordinary years. Parallel instances of these circumstances are clearly exhibited in the enormous increase in number of the larvæ of Lepidoptera in certain years; but I may add that it is apparently impossible to bring any direct proof of the true reason of that fact, and one can only form theories about the point. It is one of the many questions in the economy of nature that probably never will be solved; we only know that it is a fact.

It is, however, worthy of remark that these circumstances are always at the same time equally favourable to the increase of nearly allied species which are *quite independent of one another*. Thus in the years when *M. lemmus* migrates I have observed there is certain to be an increase above the normal number of one or more species of rats and mice (Muridæ),—in the southern parts of Norway chiefly the following Voles, *Arvicola gregarius*, *A. amphibius*, and *A. ratticeps*; in Finmark, *A. rufocanus*, *A. ratticeps*, and *A. rutilus*; further the Harvest-Mouse, *Mus sylvaticus*, and possibly other small Rodents. The increase, however, in these species never attains the magnitude that it does in *Myodes lemmus*; and none of these, as mentioned above, possess the migratory instinct in the same degree as the Lemming.

Furthermore, almost every "year of migration" and "breeding" that has taken place in the tracts below the Dovrefjeld and bordering the Trondhjemsfjord the Shrews (Soricidæ), the Hare, and most of the Grouse tribe (Tetraonidæ) have at the same time been unusually numerous. Besides there are different other animals that are generally considered to a certain extent to depend upon *M. lemmus*, as they are found in larger numbers just in the years when the Lemmings are migrating, as it is supposed, in consequence of the superfluity of food; for instance, the two species of *Mustela*, *Vulpes lagopus*, *Nyctea scandiaca*, *Asio accipitrinus*, *Buteo lagopus*, and others. In my opinion this facility in obtaining superfluity of food is not the only or true reason for the increase of numbers of these animals.

I have elsewhere stated*, *Nyctea scandiaca* increased very numerously during the summer of 1872 in many districts where there

* "Remarks on the Ornithology of Northern Norway" (Forb. Vidensk. Selsk. Christiania, 1872, p. 223).

was no migration or hyperpopulation of the Lemming, just as much as it did in those districts which were full of them.

It will, I think, be rather difficult to state in what degree the climate or the seasons have to do with this increase of animals in certain years. Thus in 1862 the Blackcocks &c. (Tetraonidæ) in the southern parts of Norway were numerous to an extent that probably has not been the case in any year since; and a great migration of the Lemming took place in the autumn in the same localities: still it is a fact that the summer was proportionally cold and rainy, and therefore, as may be suggested, not particularly suitable to the bringing up of their young. The true ground for the periodical increase in numbers is doubtless a physiological necessity for the existence of the species, the reasons for which at present it is beyond our power to explain.

The wanderings take place in *the direction of the valleys*, and therefore can branch out from the plateaux in any direction. During migrations from the Dovre district the swarms wander northwards through the valleys of Sondre Trondhjems Amt, as much as southwards through Gudbrandsdalen and Osterdalen; from the district of Jotinsfjeldene and Langfjeldene the wanderings take the western direction to the innermost parts of Bergen Stift, or an eastern course, and push their way down the valleys of Valdres, Hallingdal, and Nennedal. The most western valleys of Norway, as in Bergen Stift, are proportionally less frequently visited by them than the lowlands east of the high fells. From the High fells towards the Swedish frontier, under 62° to 63° N. lat., the wanderings branch out as much towards the districts bordering the Trondhjems fjord as the Swedish provinces Jemteland and Herjedalen, which in some years are covered with myriads of these animals that all penetrate towards the Baltic. It is seldom that the wandering flocks will cross a valley to reach a neighbouring fell; but sometimes they do: generally their course is somewhat irregular, but, on the whole, in the direction of the valley itself. They wander almost entirely in the night, and move quickly forwards. During the daytime they are, for the most part, resting or hidden amongst stones or the tussocks, though considerable numbers may be seen everywhere. Their temper and general habits are so well known that I may here omit to mention them.

During the seasons when they breed plentifully, the increase takes place abundantly on the islands, which are sometimes very small in extent; as is the case with many of the mountainous

islands of Lofoden and along the coast of Finmarken. On the islands the migrations soon cease when the sea is reached; during fine weather the animals will easily swim over fjords or lakes at least two English miles broad*.

Amongst the localities in Norway which are furthest distant from the summer dwellings of the Lemmings are Smaalenene (south-west of the Christianiafjord), the lowlands of Jadera (south of Stavanger), and the tracts bordering on the southern part of the lake Mjösen and on both sides of the Christianiafjord. But during certain years of migration these parts of the country are also covered with their swarms, and, on the whole, there perhaps is no attainable point of the country which has not during one or other year been visited by them. Each migration covers but a certain district, but never spreads simultaneously over the whole country.

The greatest migrations have generally taken place from some of the following great complex systems of fells:—

No. 1. From the plateaux of Langfjeldene and Jotinsfjeldene, sending swarms to the western portions of Christiania Stift, Christiansand Stift, and the adjacent valleys of Bergen Stift.

No. 2. From the plateaux of Dovre and the fells of Gúdbrandsdalen and Osterdalen to the northern districts of Christiania Stift and the adjacent valleys of Trondhjem Stift.

No. 3. From the fells in Trondhjem Stift towards the Swedish frontier to the tracts bordering on the Trondhjemsfjord (and Swedish Nordland).

No. 4. From the fells in Nordland to greater or smaller portions of Nordland (and the neighbouring parts of Swedish Lapland).

No. 5. From the plateaux in the interior of Finmark to different parts of Finmark.

The smaller migrations, as above stated, may only include the neighbouring valleys which are adjacent to the plateaux. As districts which in later years have been particularly visited by their swarms, may be named (No. 3), for instance, the lowlands of Inderöen and other of the innermost parts of the Trondhjemsfjord,

* Here I may add a correction to a quotation by Mr. Crotch in one of his papers (p. 32). Mr. Crotch writes that "in November 1868 [quoted by Lilljeberg, *infra*] a ship sailed for fifteen hours through a swarm of Lemmings which extended as far over the Trondhjemsfjord as the eye could reach." The notice I gave Dr. Lilljeberg, and which is quite correctly quoted in his 'Fauna,' i p. 327 (Upsala, 1874), does not state fifteen hours, but a quarter of an hour; and it was not a sailing ship, but a steamer.

where, during the last ten years, often smaller or greater migrations have taken place, and where sometimes their visits have been of the most destructive nature.

I do not think it will be of any service for me to enter into detail in describing the different ways of each wandering, as far as it is known; for this would necessitate a somewhat extensive knowledge in the reader of the local topography of the country. I only here shortly mention the years of the *greater* migrations of which I have any information, this being, as will be seen, very incomplete until within the last twenty years.

1739-40. Hallingdal (from the plateau of No. 1).

1757. Trondhjemsfjorden (from No. 3).

1769-70. Osterdalen (from No. 2); at Kongsberg (from No. 1) Mr. Crotch mentions (p. 158) a wandering the same year.

1772. Söndmör, in Bergen Stift (from No. 1).

1774. Nordmör, in Bergen Stift, south to Satersdalen in Christiansand Stift (from No. 1). Most likely this and the migration of 1772 have been connected.

1780-81. Thelemarken, Eker, Hadeladed, and Christiansand Stift (from the south portions of No. 1).

1789-90. Christians Amt and about the same parts as the preceding wandering (from No. 1).

1816. Nordland (from No. 4).

1826. Bergen Stift (from No. 1).

1833-34. Thelemarken and Christiansand Stift (from No. 1). Mr. Crotch mentions (p. 158) a wandering the same year at Bosekop in Finmark (from No. 5).

In the last decades, I know of the following *great* migrations, all, except the first, from personal observation in the places themselves:—

1852-53. In the south of Finmark and the tracts of Tromsö (from No. 5).

1862-64. Southern parts of Christiania Stift (from No. 1).

1868-69. Trondhjem Stift and the northern portions of Christiania Stift (from Nos. 2 and 3).

1871. Eastern parts of Christiania Stift (from No. 1).

1872. Trondhjem Stift and the northern parts of Christiania Stift (from Nos. 2 and 3).

1875-76. Eastern and northern parts of Christiania Stift, Christiansand Stift, and north to Romsdalen (from Nos. 1 and 2).

1876. East Finmarken (from No. 5).